

THE PRESENCE OF SPINAL DISTORTION IN THE
EARLY STAGE OF SPONDYLITIS AND ITS
VALUE AS A DIAGNOSTIC SIGN.¹

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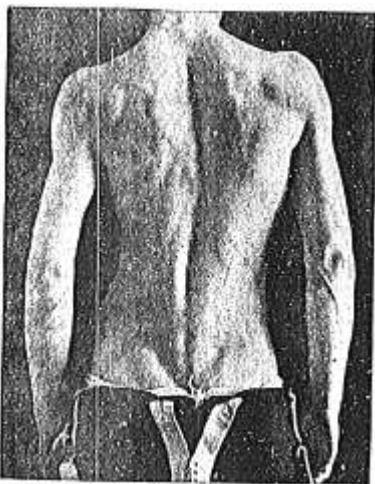
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FOLLOWING an uninterrupted course of development, spondylitis of the dorsal or lumbar vertebræ which has terminated in angular deformity, possesses a twofold appearance as regards the pathological changes that have occurred in the spinal axis. First, the commonly observed antero-posterior yielding of the column at the point corresponding with the diseased vertebræ. Second, a certain amount of pathological rotation, or distortion, of the column, and alteration of the normal relations between the column and the pelvis. It is the latter, or rotary, element of the deformity to which attention is invited in the following remarks.

Distortion of this character is referred to by many writers on surgery, though in a sparing and somewhat casual manner. This feature of the general deformity of the trunk is commonly attributed to destructive tissue changes in the vertebral body, on its lateral more than on its anterior part. The lateral deviation of the spine, which is explained in this manner, is said to be unattended by axial rotation in the column, this feature in spinal malposition being regarded as the sole characteristic of scoliosis, and in no manner belonging to the deformity of spondylitis. By some surgeons the distortion in the later stage of spondylitis is believed to have resulted from the assumption of certain postures by the patient in the effort to secure muscular fixation of the inflamed vertebræ, when they have begun to suffer from disintegration. A few text books

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on surgery contain no reference to the matter of distortion in



this connection, attention being concentrated on the occurrence of angular deformity, as if it were the inevitable sequence of the primary lesion. Distortion coexisting with angular deformity follows the same general direction as that in scoliosis, viz., rotation in the lumbar curve being toward the left side. Its relative import-

FIGS. I AND I'.—POSTERIOR AND ANTERIOR VIEWS OF THE TRUNK, SHOWING THE DISTORTION FROM OSTEITIS OF THE THIRD LUMBAR VERTEBRA.

Although the patient, a male, æt. 20 years, had indulged very actively in athletic games, the history of the case did not indicate the receipt of an especial injury of the spine. The more prominent symptoms were: Disturbance in nutrition—the patient having fallen off in his weight 15 pounds during the previous year; vertebral tenderness and pain in the lower lumbar region; a succession of attacks of painful spasm of the lumbar muscles, following lifting and flexion efforts; rigidity of the lumbar muscles in the execution of ordinary movements of the trunk; inability to overcome malposture by a forcible muscular effort. Duration about one year.

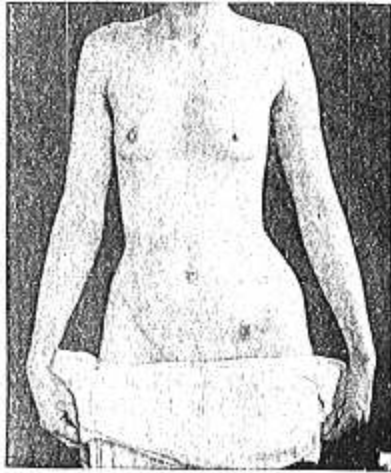


ance in the deformity of the trunk depends on the degree

of angular projection that is associated with it. Consequently there are variations in the appearance of the distortion at different periods in the growth of the angular deformity, and also variations which depend on the position in the column of the vertebra which is the especial seat of the disease. For the purpose of illustration: If a series of cases could be arranged so as to show the progressive features of spondylitis, *e. g.*, in the dorso-lumbar region, in persons of any age, excepting infants and those who have not acquired the ability to walk, it would be seen by following the development of the angular deformity in the reverse order of its occurrence, that as the angular deformity became a decreasing factor in the alterations of the spinal axis, the distortion would acquire relatively greater prominence.

On reaching the stage of the disease anterior to the appearance of angular deformity, distortion alone would constitute the changes in the figure as the effect of the vertebral lesion. At that early period of the disease it would resemble a scoliosis of slight degree, whose plane of primary rotation occupied the region of the column indicated. Variation of this type of distortion would take place, following the localization of the disease in a higher or lower part of the column; furthermore, the plane of primary rotation would be seen to correspond with the situation of the affected vertebra.

The facts that I desire to emphasize are as follows: Pathological spinal rotation is always associated with the early stage of spondylitis in the regions that I have indicated. The appearance of the distortion is varied by the position of the diseased vertebra. The distortion differs from that of scoliosis chiefly in the greater variety of its forms, and in the presence of phenomena of irritation, which may be referred to a vertebral source. Malposition of the trunk and changes in the spinal axis, in connection with early spondylitis, are vaguely described by surgical writers, as "peculiarity of attitude," "temporary lateral curvature," "abnormal appearance of the spinal curves," etc. On closer scrutiny these will be seen to consist, almost wholly, of distortion. When the disease has advanced to the stage indicated by angular deformity, the latter has the



characteristics of the earlier malposition mingled with it; and, as the antero-posterior changes advance, the rotary deviation becomes less conspicuous; but, notwithstanding this it contributes in no small degree to the general deformity of the trunk.

Careful inspection of the posterior and anterior aspects of

FIGS. 2 AND 2'.—ANTERIOR AND POSTERIOR VIEWS OF DISTORTION IN A CASE OF OSTEITIS OF THE SECOND LUMBAR VERTEBRA.

Female, *æt.* 22 years. Duration about 1 year. No history showing receipt of an injury. Pain referred to lower lumbar region, hips, thighs and lower part of abdomen. Rigidity of the right psoas muscle and also of the muscles throughout the lower half of the trunk. Vertebral tenderness was so great that the patient was unable to ride or walk without exciting great pain and prostration.



the trunk will show the distortion in early spondylitis to be

purely axial in character, *i. e.*, there are primary and compensating curves that are formed in much the same manner as in scoliosis. If it were generally the rule that the vertebral body should escape disintegration in this natural progress of the disease, the osteitis would then occasion spinal deviations that would conform in many respects to so-called rotary lateral curvature. Cases are occasionally seen which illustrate this statement; rotary lateral deformity has been observed to have followed an injury of the spine, and the occurrence of osteitis in a vertebra which, having been progressive over a long



FIG. 3.—THE PATIENT SHOWN IN FIG. 2 AFTER AN INTERVAL OF SIX WEEKS.

During the interval the distortion had been overcome by treatment—bringing into view a slight angular deformity which had been obscured by the distortion.

period of time, has not terminated in angular deformity, but has been characterized by distortion, from beginning to end. Such cases simply illustrate the tendency which the deformity has to assume, the characteristics of spinal rotation when, underlying or following the lesion, there are not those specific qualities which induce degenerative changes in and destroy the weight-bearing

function of, the vertebra.

I have laid stress upon this matter of axial rotation chiefly because its presence in the distortion of spondylitis has been disputed by many surgical writers, and, also, because the distinction between early spondylitis and scoliosis has been made to rest on the absence, in the former, of this peculiar quality in the distortion.

By referring to the accompanying illustrations from photo-

graphs of cases of spondylitis in its early stage, it may seem at a glance that the distortion possesses those characteristics of axial rotation which may be observed in scoliosis, and which are usually ascribed to scoliosis alone. In addition to the presence of distortion in these cases there were, briefly, the rational signs of osteitis or epiphysitis, evinced by tenderness of a vertebral body to concussion and pressure, rigidity of the spine from reflex and voluntary muscular contraction, and irritation of those spinal nerves which emerged from their foramina in near relation to the focus of disease. There was the



FIG 4.—DISTORTION ATTENDING OSTEITIS IN THE REGION OF THE TWELFTH DORSAL AND FIRST LUMBAR VERTEBRÆ.

In a female patient, æt. 19 years. The disease followed the receipt of a severe spinal injury, by falling from a height of twelve feet, striking the back upon the ground. Duration nine months. Pain referred to the dorso-lumbar and lower abdominal regions. Moderate rigidity of spinal muscles, and also of the right psoas. Painful spasm of the lumbar muscles had occurred a number of times during the development of the disease.

presumption of a tuberculous origin of the disease in a large proportion of the number, notwithstanding the fact that traumatism appeared to have been an exciting agent quite frequently. In a few instances, however, traumatism alone

seemed to be responsible for the origin and progress of the disease.

The accompanying illustrations show, quite accurately, the varying appearance which the distortion assumes, by reason of



its plane of primary rotation having a position at the same height in the column as that of the irritative lesion. A number of patients in whom the disease is similarly situated, as regards the vertebra that is especially involved, may present distortion of different degrees of severity, but the close relation between the type of distortion and the site of the disease will

FIGS. 5 AND 5'.—DISTORTION PRESENTED IN A CASE WHERE THERE WERE EVIDENCES OF EPIPHYSITIS IN THE TWELFTH DORSAL VERTEBRA.

In the patient, a boy *æt.* 8 years, the duration of the disease was about six months; at intervals during the latter half of that period there had been three paroxysms of painful spasm of the lumbar muscles following bending movements of the spine. No history pointing to traumatism. Family history of tuberculosis. Pain was referred to the dorso-lumbar and abdominal regions. Well-marked rigidity of the lower dorsal and lumbar vertebræ during the execution of ordinary movements.



be always preserved. When these changes in the spinal axis are associated with phenomena of irritation, of the kind that has been alluded to, they may be regarded as possessing a diagnostic value, as significant of the early stage of spondylitis as angular deformity in the advanced stage.

This deformity in the early stage of spondylitis especially resembles scoliosis, when it has been slow in development and has excited irritation of a slight degree only. It is this class



of cases in which the mistake of regarding the disease as scoliosis is most frequently made. By close observation of the forms of irritation associated with distortion, its vertebral source may, as a rule, be easily determined. This is especially the case when it is manifested through the spinal nerves in

FIGS. 6 AND 6'.—DISTORTION DUE TO EPPHYSITIS IN THE ELEVENTH DORSAL VERTEBRA.

A girl, *æt.* 7 years. Duration about six months. No history of traumatism. Development of symptoms of irritation and spinal weakness, followed an attack of measles. Pain referred to the back and the abdomen, and to the course of the spinal nerves. Emerging, at the vertebra indicated. Pain excited by slight concussion passing through the vertebral axis, flexion movements of the spine, and by digital pressure upon the spinous process of the eleventh dorsal vertebra.



close proximity to the disease. A mild galvanic current passed through these nerves often serves to indicate accurate-

ly the part of the column from which irritation emanates, when, otherwise, its expression would be feeble and obscure as pointing to its origin. When there has been a short period of latency of the disease—notably in cases where a severe injury has preceded its development—the distortion is not defined quite as clearly, but, owing to the prominence of the fact of a traumatism, and the more pronounced manner in which irritation is generally manifested, the disease is less liable to be overlooked, or its character wrongly interpreted in its early stage. A slight degree of distortion may be easily ascertained to be present in a patient by viewing the trunk in profile against a dark background. Spinal deviation having first been determined in this manner, the rotation in the several regions and also of the pelvis will be more clearly appreciated; the anterior aspect of the trunk often presents better evidences of distortion than the back. By directing patients to extend the arms upward—in this manner elevating the scapulae—a greater extent of the contour of the thorax is exposed, permitting a more accurate estimate to be made of the degree of distortion that is present.

I have been unable to learn that the phenomenon of spinal distortion has been especially referred to by surgical writers in a manner, as stated in the foregoing remarks, to indicate that it is always present in the early stage of spondylitis. In this connection a few writers make mention of the matter as an event of occasional or transient occurrence, but its presence or significance is only vaguely alluded to at best. Those symptoms of the early stage, which are more plainly expressive of irritation, have received the greatest share of attention, but, as a rule, these are not actually very conspicuous until the disease has made a considerable amount of progress.

The arrangement of the latter signs, so as to fairly represent an average case at an early period of its development, will therefore tend to magnify them, so that they will quite as often indicate the advanced stage of the disease. To rely wholly on the symptoms of irritation for determining the existence of incipient disease in a vertebra is, without doubt, a frequent cause of oversight in diagnosis of the disease prior to the development of angular deformity. By giving a prominent place

to the phenomenon of spinal distortion in the symptomatology of early spondylitis, we would become possessed at once of a landmark around which the more obscure signs of irritation, such as usually characterize that stage of the disease, so that they could be intelligently arranged and assigned to their proper source.



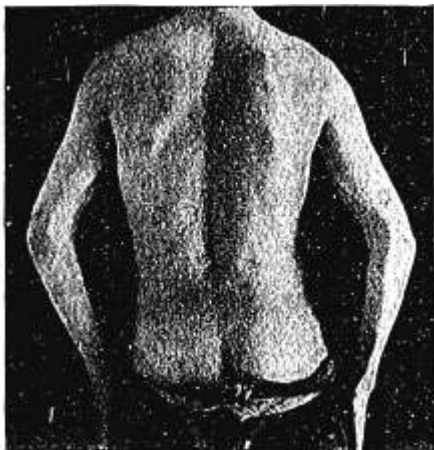
The recognition of the disease in this early stage will enable the surgeon, by the prompt employment of restraining measures, to prevent the development of angular deformity. The loss of this opportunity, though but slight angular deformity may have resulted, imposes a three-fold greater amount of time upon the period of treatment necessary for the arrest of the disease. In ad-

FIGS. 7 AND 7'. — DISTORTION WITH OSTEITIS OF THE TENTH DORSAL VERTEBRA.

In a male patient, *æt.* 21 years, the duration of the symptoms of irritation had been about four months; shortly before they made their appearance the patient strained his spine severely while lifting a heavy weight. Pain was referred to the back, abdomen, and course of the spinal nerves, in the region indicated. Pain felt in the affected vertebra following slight concussion or flexion movements of the spine. Muscular stiffness quite apparent in the movements of the trunk.



dition, there will be a moderate increase of deformity during that time, despite the most perfect spinal restraint that can be enforced.



FIGS. 8 AND 8'—POSTERIOR AND ANTERIOR VIEWS OF THE DISTORTION WITH OSTEITIS IN THE NINTH DORSAL VERTEBRA.

In a male patient, *æt.* 40 years, the duration of the disease had been about one year. No history pointing to the receipt of a traumatism prior to the development of the signs of irritation. Concussion tenderness of the vertebra unusually well marked. Pain referred to the back, and to the spinal nerves corresponding with the affected vertebra. Abdominal pain constantly felt, and frequently developing into paroxysms resembling gastralgia. Spinal rigidity present in marked degree in the region of the affected bone. Patient had been obliged to maintain the recumbent position during a part of each day, for a period of six months preceding.



The rationale of the relation of pathological spinal rotation to spondylitis does not seem difficult of explanation, in view of what is known of some of the uses that are made of normal spinal rotation. During the standing or sitting position the spinal muscles may be temporarily rested when an attitude is assumed in which vertebral rotation is the principal factor. In

this physiological position the weight that each vertebra then sustains rests obliquely upon it, being directed toward one side

of the vertebral body and upon the articular process of the same side. When a vertebral body, or one of its epiphyses, is in a state of inflammation this position is adopted for the purpose of minimizing pressure upon it from the weight of the superincumbent parts. The rotary movement is adapted to the especial wants of the affected vertebra, giving rise to what has been designated, in this connection, as the plane of primary rotation. Voluntary and reflex contraction in the spinal muscles tend to immobilize the region of the spine in which the disease is situated; and, by adapted contraction, this assumed attitude becomes a malposition through inability of the patient to restore the spinal curves to their place in the median line. Degenerative changes ensuing in the inflamed vertebral tissues impose a new course upon the spinal deviation, but, notwithstanding this, the earlier distortion is only partially effaced.

The resemblance of the distortion in early spondylitis to scoliosis, and the explanation that has been offered of its mode of occurrence, leads naturally to an inquiry regarding the origin of distortion in scoliosis, possessing, as the latter does, so many similar features, but for whose existence a vertebral lesion has not been deemed necessary, by a large number of writers on the subject. Accepting the theory that scoliosis depends on a modified form of rachitis, the occurrence of distortion may be accounted for by a condition somewhat similar to that assigned as its cause in spondylitis, viz., vertebral irritation. That the rachitic disorder excites irritation in the epiphyseal and periosteal tissues is easily demonstrated by making slight pressure upon the swollen epiphyses, *e. g.*, in the femur, tibia or radius. It is a reasonable inference to suppose that the epiphyseal cartilages in the vertebræ would also be irritated by pressure, exerted upon them by the weight which they sustain during the maintenance of the erect position. Under those circumstances spinal rotation would be the posture naturally assumed to relieve the vertebræ, in part, of direct pressure. The effect of pressure directed upon the vertebral bodies, in this manner, would induce the characteristic wedge-shaped alteration, as the result of their impaired resistance, in the same manner that analogous changes are induced



FIGS. 9 AND 9'.—POSTERIOR AND ANTERIOR VIEWS OF DISTORTION FROM EPIPHYSITIS IN REGION OF THE SIXTH DORSAL VERTEBRA.

A boy, *æt.* 15 years. No history of a spinal injury. Symptoms of irritation confined chiefly to the course and distribution of the corresponding spinal nerves. Pre-sure and concussion tenderness manifested in the region of the vertebra indicated.

in the epiphyses of the long bones from similar causes. Viewed in this light, the lounging, drooping attitudes, so universally observed in scoliotic subjects, are simply the expressions of vertebral sensitiveness, which those patients try to diminish by adopting a position that affords them a certain amount of relief. The distortion has become confirmed when the patient has lost the

power to restore the curves to the normal position, owing to alteration in the form of the vertebral bodies, and adaptive shortening of those muscles whose points of origin and insertion have become approximated from the habitual maintenance of this posture.



As regards the method of treatment to be employed in the early stage of spondylitis, whatever plan is adopted, it should embody those measures by which the inflamed bone will be protected from the effects of pressure and movement, incident to functional use, in the same degree that has been deemed essential in the advanced stage of the disease. The distortion in this stage is such as to admit of entire correction, inasmuch as it depends only on muscular contraction and gravity. It has been previously stated that the patient is unable to overcome the distortion by any effort of his muscles that he is able to exert. Another feature of the distortion is its reluctance to yield, except in slight degree, to extension force that is rapidly applied while the patient is in the erect position, *e. g.*, by head and axillary suspension. Extension of the spine of this character is firmly resisted by reflex muscular contraction, sufficient to oppose all reasonable efforts to make the spinal curves retrogress into their median position.

I have repeatedly applied the plaster of Paris jacket in these cases,

while the patient has been completely suspended, but have never succeeded, by these means, in removing more than a small proportion of the distortion.

From the effect of recumbency to remove all pressure from the vertebrae, it becomes one of the most efficient measures that can be employed for the correction of spinal distortion. Of itself, however, it is not sufficient unless it is maintained so



FIG. 10.--DISTORTION IN OSTEITIS OF THE FOURTH DORSAL VERTEBRA.

A female patient, *æt.* 20 years. Duration about one year. No injury of the spine had been received. Family history of tuberculosis. Pain referred to the distribution of the corresponding spinal nerves. Reflex irritations indicated by nausea, palpitations, and attacks resembling *petit mal*.

thoroughly, and for such a prolonged period of time, as to be next to unbearable by the patient; its employment, therefore, as an exclusive method of treatment, is not generally practicable or desirable. In making use of the recumbent position as an adjuvant in the orthopædic treatment of distortion, it is important to supplement its action by measures such as will reduce the period of confinement to the minimum of time, and, at the same time secure its advantages when the patient shall have resumed the erect position. Methods of treatment in the early stage of spondylitis which impose spinal fixation by means of rigid supports or "jackets," formed upon the body of the patient while he is suspended, do not fulfil the indications for treatment, as regards the correction of distortion. For reasons already stated, an appliance of that character, at the time of its application, maintains a large proportion of the distortion in a manner to render it unchangeable during the continuance of such support; furthermore, it exerts no influence for the removal of distortion by its modifying effect on the morbid process in the vertebra. Repeated suspension and reapplication of the "jacket" will not accomplish the desired correction of malposition, for the reason that the previous fixation of the spine in a faulty position for a long period of time has contributed still further to establish the distortion and induce greater resistance to its removal by suspension than excited in the first instance. If by these methods the progress of the disease is restrained and angular deformity prevented, there will be a residue of permanent distortion following the subsidence of the morbid process; this is not only unnecessary deformity, but it is also a menace to the health of the patient from possessing the conditions for further progress, under favoring circumstances, as rotary lateral deviation.

To meet these defects in this commonly employed method of treatment, in the early stage of spondylitis, I have modified the shape of the supporting jacket so as to cause it to exert a correcting effect also upon the distortion. Instead, therefore, of making a jacket that accurately fits the distorted figure, the latter is secured in one that corresponds to the form of the trunk when the spine is in its normal median position. Such an appliance cannot be readily obtained by moulding the mate-

rial of which it is composed upon the body of the patient, and then by removing the jacket, and while it still retains its plastic qualities, changing its form by manipulation, so as to effect the correction of the distortion. This, which at first glance would appear to be an ideal method of making a jacket that

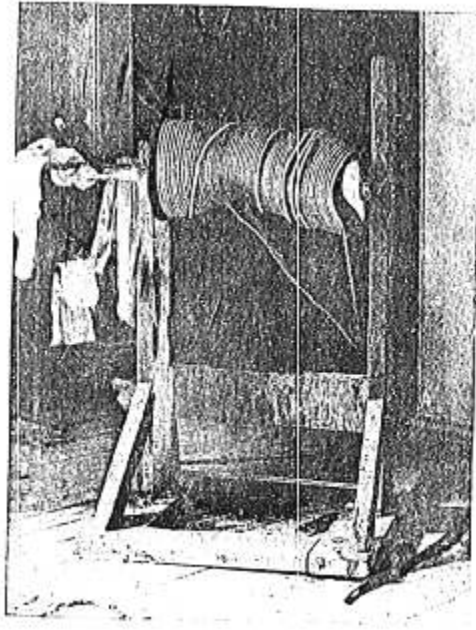


FIG. 11.—PLASTER OF PARIS CAST PLACED IN A FRAME FOR MAKING THE LEATHER JACKET.

Shows the leather jacket formed on the cast by means of a rope placed in tightly drawn strands around the leather while the cast is turned in the frame.

would conform to the normal form of the patient's body, is impracticable, by reason of the intricate nature of the changes that occur from the distortion. The difficulty is more easily and perfectly overcome through the medium of a plaster of Paris cast of the patient's figure—using the plaster of Paris jacket for a mould. The cast thus made may be subjected to

a process of modelling, with a view of reversing the rotary deviations to an extent such as will make the shape of the cast, when they are corrected, correspond to that of the patient, with the spine in the normal erect position.

Upon this straightened cast the "jacket" may be formed, from some material having the requisite pliability when softened to be easily moulded into the desired shape, and which will also possess, when it has become hard, a proper amount of resistance to restrain the spine in that position which the jacket tends to cause it, gradually, to adopt. In the matter of material from which to make the jacket, my preference thus far is for leather, such as is used for making machinery belting. A piece of the proper size is thoroughly soaked in warm water and wrapped around the cast being made to lap in front, a distance of eight inches, after the manner of a double-breasted coat. The leather is forced to take the shape of the cast by winding a strong rope tightly around it—having the strands lie close to one another throughout the whole extent of the form; if necessary the rope must be hammered down firmly upon the leather, as each successive strand is drawn around, and finally, it may be thoroughly moistened to cause it to force the leather with still greater power upon the cast.

These manipulations may more conveniently be performed by having the cast rest in a frame by means of a strong stick of wood pushed longitudinally through it at the time of making the cast. The whole may then be turned by a handle, after the manner of a winch—the rope being held meanwhile so as to be drawn about the leather with a considerable degree of tension. (See Fig. 11.) The rope having been unwound, the edge of the outside lap of leather is nailed through to the cast, and, the leather having been perforated freely with a No. 12 punch, the whole is placed over a heater, or in the sun, to dry. When sufficiently dry the nails are withdrawn from the leather jacket which has thus been formed, and it is sprung off from the cast; the edges are then to be properly trimmed, the inner surface made thin by sandpaper, and several coats of shellac applied outside and inside to make it water-proof. Four strong webbing straps encircling the jacket are fastened to it at equal distances apart. In fastening it upon the patient by

these means, the lapping of the leather permits of a slight amount of gliding movement that in the adjustment of the jacket secures uniform support.

The straight-jacket having been placed upon the patient, he is made to assume the recumbent position before it is tightened. In this manner the effect of spinal extension induced by recumbency is secured to the patient when he resumes the standing or sitting position. (See Fig. 12).



FIG. 12.—FINISHED LEATHER STRAIGHT-JACKET APPLIED TO PATIENT.

Represents Fig. 2 shortly after the first application of the jacket. Correction of a large proportion of the distortion is shown by the improved position of the patient when standing.

As the straight-jacket offers no resistance to the replacement of parts that have deviated, there will be a slight amount of correction of the rotation induced by each repetition of this operation. It frequently happens that the distortion is wholly removed during the first ten days following the application of the jacket—the patient's spine being then supported in the position of normal erection.

The subsequent management of the matter consists chiefly

of fixation of the affected region of the column, in the manner indicated, pending the subsidence of the inflammatory process.

This method of treating spinal distortion may be employed with successful results in scoliosis of a slight or moderate degree. In this connection, however, spinal support must be used conjointly with special exercises, massage, electricity, etc., designed to restore muscular tone and vigor, in order that following a period of spinal restraint in the normal position, the natural supporting structures may successfully resume their functions on the withdrawal of artificial aids.

By these means it is possible to avoid recourse to the successive application of the plaster of Paris jacket for attaining the same end. Should the leather straight-jacket tend to lose its shape after having been worn for a time, it may easily be restored to its original shape by softening it in warm water and moulding it again upon the plaster of Paris cast. Its corrective force may thus be exerted continuously while the jacket is being worn—this being a feature of especial value in certain cases in which the rotary deviations are overcome only slowly and after a prolonged period of treatment.